LA-UR-18-23117
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Title: 35Cl(n,p)35S Reaction Cross-Section Using Monoenergetic Neutrons in the Intermediate and Fast Energy Regions

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Intended for: Letter of Intent for Funding call

Issued: 2018-04-11

LETTER OF INTENT

To the Nuclear Data Interagency Working Group / Research Program
DOE National Laboratory Announcement Number: LAB 18-1903

$^{35}Cl(n,p)^{35}S$ Reaction Cross-Section Using Monoenergetic Neutrons in the Intermediate and Fast Energy Regions

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Abstract

The $^{35}Cl(n,p)^{35}S$ reaction plays an important role in the operation of Molten Salt Reactors (MSR). Chlorine has two stable isotopes, ^{35}Cl and ^{37}Cl, with natural abundances of 75% and 25%, respectively. Due to concerns with the large capture cross-section of ^{35}Cl, Salts enriched in ^{37}Cl are more desirable, however, there will always be traces of ^{35}Cl and enrichment is not always feasible. Therefore, neutron capture on ^{35}Cl, along with other neutron depleting reactions such as the $^{35}Cl(n,p)^{35}S$ reaction, play a critical role in the MSR operation. In the intermediate and fast regions, there are currently no experimental data to constrain the (n,p) cross-section and only data below ~100 keV and at 14 MeV exist [1,2]. According to a recent DOE report on nuclear data needs [3], recent changes to the ENDF evaluation for this reaction have produced reactivity changes in reactor codes of 1000's of pcm; a unit of measure of the reactivity of the system. Given this level of uncertainty it is desirable to obtain experimental cross section data in the 0.5 – 14 MeV region.

In response to the request in the FOA, we are proposing to measure the $^{35}Cl(n,p)^{35}S$ reaction cross section, using activation techniques, in the intermediate (0.5-1 MeV) and fast regions (1-14 MeV). These measurements will be performed at the Triangle Universities Nuclear Laboratory (TUNL) using their 10 MV Tandem Van de Graff accelerator, that is capable of producing quasi-monoenergetic neutrons from a number of proton and deuteron reactions. These measurements would leverage an existing collaboration between Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL) and TUNL that has been making energy dependent fission product yield measurements [4]. We would utilize the existing fission chambers (and people) from this collaboration as a means of normalization of the $^{35}Cl(n,p)^{35}S$ reaction, using the ^{238}U fission cross-section standard [5]. Samples, in the form of a chloride (e.g. KCl), would be irradiated at TUNL and then returned to LANL for dissolution and liquid scintillation counting of the beta coming from the ^{35}S decay. Since ^{35}S has a relatively long half-life of 87 days, it will be possible to temporally deconvolute possible background contaminations from other reactions.

References:

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[5] D.A. Brown, et. al., Nuclear Data Sheets 148, (2018) 1-142

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